TC-P_06 Greenhouse gas emissions and crop yields under different organic fertilizers and irrigation treatments in a Mediterranean maize field

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Objectives

In this experiment, we aimed to assess the effect of different organic amendments (pig urine (PU); pig urine with the nitrification inhibitor 3,4 dimethylpyrazolephosphate (DMPP, PUI); compost from the solid phase of pig slurry (PC)) compared to urea (U); and two different irrigation systems (sprinkler and drip) on greenhouse gas (GHG) emissions, crop yield and Nitrogen Use Efficiency (NUE) in a maize (*Zea mays* L.) crop.

Methodology

The study was carried out in "El Encín" field station (Madrid, Spain). All the irrigation and fertilizer treatments were assigned in a three-replicated completely randomized design. A control with no N fertilization was also included, while the rest of the plots were fertilized with 180 kg N ha-1. Maize was seeded on 7th May 2014 (resulting in a plant population of 7.5 plants m-2) and harvested on 24th October 2014. Greenhouse gas emissions were sampled by the static closed chambers method, and quantified by gas cromatography.

Results

Only PUI significantly decreased nitrous oxide (N_2O) cumulative emissions compared to the synthetic fertilizer (U). Nitrous oxide fluxes were higher in sprinkler than in drip irrigated plots. By contrast, U and sprinkler were the treatments that resulted in highest methane (CH_4) uptake in fertilization and irrigation factors, respectively. Cumulative respiration rates were greater in PC and sprinkler irrigation plots. Urea led to higher biomass yield than all organic treatments, although grain yield was not significantly different in U and PUI plots. Drip irrigation resulted in greater biomass production in C, PU and U treatments. Nitrogen Use Efficiency decreased in the order: U > PUI = PU > COM. When considering the Yield-Scaled N_2O emissions ratio (g N-N_2O kg^{-1} N uptake or mg N_2O kg^{-1} grain), COM and PUI showed the highest and lowest values, respectively. Drip irrigation also minimized cumulative N_2O fluxes per kilogram of N uptake or grain yielded.

Conclusion

Management strategies as combining organic fertilizers (PU) with nitrification inhibitors (DMPP) and drip irrigation may provide the best balance among GHG mitigation [1],[2], obtaining similar grain yields to those of U and reducing environmental impacts arising from a wrong management of animal residues while abating farm costs associated with the use of synthetic fertilizers; and favoring and improvement of physical, chemical and biological fertility of soils [3], which is crucial in semi-arid soils.

References

[1] Chadwick, D.; Sommer, S.; Thorman, R.; Fangueiro, D.; Cardenas, L.; Amon, B.; Misse brook, T. (2011). Manure management: implications for greenhouse gas emissions. Animal Feed Science and Technology 166, 514-531

[2] Sanchez-Martín, L.; Meijide, A.; Garcia-Torres, L.; Vallejo, A. (2010). Combination of drip irrigation and organic fertilizer for mitigating emissions of nitrogen oxides in semiarid climate. Agriculture, ecosystems & environment 137(1), 99-107

[3] Thangarajan, R.; Bolan, N.S.; Tian, G.; Naidu, R.; Kunhikrishnan, A. (2013). Role of organic amendment application on greenhouse gas emission from soil. Science of the Total Environment 465, 72-96